

# **Standard EC Application for the Dark Energy Survey Collaboration**

**Project: Deriving Milky Way parameters with DES photometry**

**Léo Girardi –**

Osservatorio Astronomico di Padova INAF, Vicolo dell'Osservatorio 5, 35122 Padova, Italy,  
phone: +39-049-8293475, email: [leo.girardi@oapd.inaf.it](mailto:leo.girardi@oapd.inaf.it)

and

**Martin A.T. Groenewegen –**

Royal Observatory of Belgium, Ringlaan 3, B-1180 Brussels, Belgium  
phone: +32-02-3730203, email: [marting@oma.be](mailto:marting@oma.be)

**Working Group:  
Milky Way**

## **Brief description of the project:**

We propose to derive improved structural and population parameters – scale heights and lengths, age and metallicity distributions – for the Milky Way (MW) components using DES photometry, coupled with other public databases (e.g. SDSS, 2MASS, Hipparcos, etc.). This work is primarily aimed at setting constraints on the history of classical MW components such as the thin disk, thick disk, and halo. However, for obvious reasons we should also take into account the over-densities caused by any dwarf galaxy or stream eventually found in the DES imaging. Thus, the scope of our application is limited to analysis of the DES stellar sample. Our project would include the following steps:

1. A characterization of the photometric errors, completeness, crowding and contamination by galaxies, as a function of DES colors and magnitudes. This step would aim at identifying a “photometrically-complete stellar sample”, and would proceed with the help of the DES-Brasil team.
2. Modeling of the same samples for many lines-of-sight across the DES footprint, using the TRILEGAL population synthesis tool (Girardi et al. 2005, A&A 436, 895) with default parameters.
3. To perform a likelihood-maximization (or chi-squared minimization) of these parameters using the BFGS optimization algorithm, as done by Vanhollebeke et al. (2009, A&A 498, 95) for the MW Bulge. The final goal is the derivation of the set of parameters that best-fits the star counts (as a function of magnitudes and colors) in DES data. To be more meaningful, the process would also make use of already-existing data complementary to DES, such as 2MASS, UKIDSS, SDSS, Hipparcos.
4. The previous step is already feasible with present algorithms and computers, but only if limited to a few (<50) lines-of-sight. Along the project, we would discuss and test new strategies to include the most area in a single optimization run. We would also test a few possible ways of speeding up TRILEGAL.

5. The work would proceed via small, incremental optimization runs, including more and more lines-of-sight, filters, external catalogues, and MW parameters, as the survey proceeds.

**Note 1:** We foresee that this project would initially require about 0.2 FTE of L.G.'s time, and 0.1 FTE of M.G.'s time. This time fraction is maybe an underestimate considering the challenges that will be offered by the huge DES dataset. We would be willing to train either a PhD student or a postdoc (possibly from the Brazilian team) into this process.

**Note 2:** During the work, we would be using pieces of python code written by Evelien Vanhollebeke, a former PhD student at Leuven University, co-supervised by M.G. Since Evelien left astronomy, there will be no direct interaction with her. However, it would be appropriate to include her as co-author in at least one paper derived from this project. Permission to include her name will be asked in due time, but is independent from this specific Application.

### Brief CV of the applicants:

#### Leo Girardi

**Basic data:** Born in Brazil in 1967. All university studies carried on at Instituto de Fisica, UFRGS, in Porto Alegre, Brazil. PhD degree in Physics in 1996. Alexander von Humboldt fellow at Max-Planck-Institut für Astrophysik (1997-99). Several short-term fellowships in Brazil and Italy since then. Staff Researcher at the Istituto Nazionale di Astrofisica, in Italy, since 2001.

#### Recent and present main activities:

- Research in many aspects of stellar evolution and population synthesis, presently centered on the latest evolutionary stages. Member of the Padova stellar evolution group, and responsible for its widely used web services (<http://stev.oapd.inaf.it>).
- PI and main developer of TRILEGAL (TRIdimensional model of the GALaxy), a simulator of multiband photometry of resolved stellar populations (<http://stev.oapd.inaf.it/trilegal>).
- Member of the SDSS-III (Sloan Digital Sky Survey III) collaboration, in the Brazilian Participation Group, and LINEA. Participates mainly in the planning of APOGEE (Apache Point Observatory Galactic Evolution Experiment).
- PI of the Cycle 18 HST proposal GO-12257 "The nature of multiple main sequence turn-offs and dual red clumps in Magellanic Cloud star clusters". PI of an ASI-INAF I/009/10/0 project on "Star cluster and fields in the Magellanic Clouds and Andromeda: unveiling their secrets with HST".
- Coordinator of the SFH-recovery group of the VISTA Survey of the Magellanic Clouds (VMC), an ESO Public Survey (PI: M.-R. Cioni; see <http://star.herts.ac.uk/~mcioni/vmc>) providing deep near-infrared imaging and photometry over most of the Magellanic Clouds.
- Co-I of the PHAT (Panchromatic Hubble Andromeda Treasury), an HST Multi-Cycle Treasury survey (PI: J. Dalcanton, 828 orbits) which is mapping 1/4 of M31 in 6 filters. Coordinates the "improving stellar evolution" task group.

**Publications:** Co-author of 91 refereed articles, and 82 non-refereed, totaling 6315 citations in ADS (3223 as first author). The h-factor is 36.

### **Martin Groenewegen**

**Basic data:** Born in the Netherlands in 1964. M.Sc. Degree in Astronomy from the University of Utrecht in 1988, Ph.D. Degree in Astronomy from the University of Amsterdam in 1993. Post-doctoral positions at the Institut d'Astrophysique de Paris (IAP, 1993-1995), the Max-Planck-Institut für Astrophysik (1995-2000), ESO Garching (2000-2001), and the Instituut voor Sterrenkunde of the University of Leuven (2001-2008). Permanent position at the Royal Observatory of Belgium since 2008.

### **Recent and present main activities:**

- PI of the *Herschel* Guaranteed Time Key Program MESS (Mass loss of Evolved Stars), see Groenewegen et al. (2011, A&A 526, A162). The program takes far-infrared images of about 100 evolved objects (AGB, RSG, SNe remnants, LBV and WR objects) and far-infrared spectra of about 40 objects. The program is quite successful and led to the first *Nature* paper based on *Herschel* data (Decin et al. 2010 Nature 467, 64).
- CoI of the ESO VISTA Public Survey VMC (VISTA survey of the Magellanic Clouds), responsible for the analysis of data regarding AGB stars (see Gullieuszik et al. 2011 ArXiv 1110.4497).
- CoI of the ESO Large Program “A joint venture in the red: the *Herschel*+MIDI+VISIR view on mass loss from evolved stars” (PI. Claudia Paladini, Vienna), and the ESO Spectroscopic Public Survey GES (Gaia-ESO Survey, PIs Gilmore and Randich).
- Actively working in the field of dust radiative transfer modelling of the winds around late-type stars (e.g. Groenewegen et al. 2009, A&A 506, 1277).
- Member of the Scientific Advisory Committee of the European Virtual Observatory Initiative (July 2009 – present); Belgian representative in the ESO User Committee (February 2009 – present); Member of the ESO OPC for Periods 73 through 78 and 80; Coordinator of the Belgian Guaranteed Time on ESO's VLT Interferometer Sub-Array (VISA) (June 2005 – present); Member of the Belgian National ESO Committee (BNEC) (June 2002 – present).

**Publications:** Co-author of 147 refereed articles (63 as first author), totaling 5970 citations in ADS. The h-factor is 41.

### **Brief description of expertise and resources brought by the applicants to the project:**

Our scientific activity is concentrated in the observation, modeling and interpretation of resolved stellar populations in nearby galaxies. Aspects covered are the computation of stellar evolutionary tracks, simulations of composite populations in galaxies, age-dating

of stellar populations in the Local Group, calibration of the distance scale, etc. In the context of this project it is worth mentioning that:

- L.G. has for many years provided the community with stellar evolutionary tracks, isochrones, and simulations of the photometry in many systems comprising SDSS, 2MASS, UKIDSS and VISTA. There is a continuous activity in both extending the database of photometric systems, and improving the spectral libraries and zero-points in which these simulations are based.
- L.G. and M.G. are the main authors of the TRILEGAL code (Girardi et al. 2005, A&A 436, 895) for the simulation of resolved stellar populations in many photometric systems. The code is being continuously improved either with the expansion of the database of stellar models, and with a recalibration of the geometry of Milky Way components and their star formation parameters (e.g. Vanhollebeke et al. 2009, A&A 498, 95).

The resources and expertise that the applicants bring are a substantial addition to that currently available within the DES collaboration.

#### Duration of the proposed collaboration:

As long as necessary to explore the entire DES point source catalogues. We estimate a minimum of one year and a maximum of three years for the duration of the work, from the initial assessment of the DES stellar sample to the final publications.

#### Requirements for access to DES data:

There are no special requirements. The necessary data are:

- The stellar catalogues
- A small sample of the images used to derive the stellar catalogues. The aim of these images is just to perform a set of artificial star tests to check the completeness and photometric errors as a function of magnitude and galactic coordinates. *In case detailed evaluation of these functions is already provided by other working groups, we would not need any images.*
- Updated information about the photometric zero-points and passbands.

#### Anticipated publications:

We would target at least one publication before every Data Release, concerning the improved constraints to MW models provided by that specific (incremental) dataset.

#### Any other relevant information:

L.G. is already collaborating with DES-Brazil and the MW working group in the Data Challenge simulations. This involvement is demonstrated by the Rossetto et al. (2010) paper, and by L.G.'s participation in the DES Collaboration Meeting in Madrid, in May 2010.

The stellar component included in DC5 is already the result from simulations made with the TRILEGAL code using standard parameters and the DES filter transmission curves. A few extensions were prepared specifically for DC6, like the improved simulations of kinematics, validated with UCAC3 data. We can continue producing such simulations after the survey starts, as a tool to help in the interpretation of the data. Indeed, the mock data may be inserted on the real images to test algorithms of galaxy-star separation, photometric parallaxes, and the identification of stellar streams and dwarf galaxies.

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**Time Sensitive: DES External Collaborator application from Leo Girardi and Martin Groenewegen**

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**Basilio Santiago** <basilio.santiago@ufrgs.br>  
To: David Gerdes <gerdes@umich.edu>  
Cc: yanny@fnal.gov

Mon, Oct 15, 2012 at 6:07 PM

Dear David,

We have circulated the EC application from Leo Girardi and Martin Groenewegen to the MWWG. There were a few positive replies, with no objections. I do not foresee any conflict between the goals stated in the application with planned work from the group members. And yes, Leo and Martin will certainly add expertise on how to best fit structural models of the Galaxy to the DES data.

Cheers,

Basílio Santiago.

Em 2012-10-01 14:28, David Gerdes escreveu:

[Quoted text hidden]

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Basilio Xavier Santiago  
[basilio.santiago@ufrgs.br](mailto:basilio.santiago@ufrgs.br)